Bats of Fraser Island

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ABSTRACT

The occurrence of megachiropterans and microchiropterans on Fraser Island was examined using a combination of visual observations, mist nets, harp traps, and ultrasonic detection. The distribution and activity were examined in relation to vegetation categories. Eighteen bat species were recorded in the survey area, making bats the most numerous mammal group on Fraser Island. The greatest number of species was found over water and in woodland. The highest bat activity levels on vehicle transects occurred in heath and open forest. *Miniopterus australis* and *Nyctinomus australis* were widespread and were recorded in most of the vegetation categories. Five species were captured in mist nets and harp traps, five solely from spotlighting, five from vehicle transects and thirteen from on-foot and remote detection. The biases and the importance of using a combination of survey techniques are discussed.

INTRODUCTION

Fraser Island in south-east Queensland is a sand island which was declared a World Heritage Area in December 1992. Identification of its fauna is an essential precursor to managing the island to maintain it is faunal diversity. Little information is available on the bat fauna of Fraser Island, as is the case in many areas of Australia. Eight species of bats were recorded at Fraser Island in the two previous surveys that sampled bat fauna. Barry and Campbell (1978) recorded three bat species and John Kehl and Chris Corben (pers. comm.) listed an additional five species in their submission to the World Heritage Authority. Dwyer *et al.* (1979) listed five bat species from "incidental" mist netting during an extensive fauna survey of the nearby Cooloola region on the mainland. On the basis of field guides and published maps, 21 bat species could be predicted to occur on Fraser Island (Hall and Richards 1979; Parnaby 1992; Strahan 1995).

Fraser Island supports a wide range of vegetation types, from sand dunes, low heath and swamps to closed forest (Barry and Campbell 1978). Such diversity in vegetation could be expected to support an equally diverse bat fauna at that latitude in eastern Australia (Hall 1984).

The previously low survey effort for bats on Fraser Island is surprising considering it's World Heritage listing and proximity to Brisbane. This study aimed to rectify this by providing data on the presence of bat species on the island, and in the range of vegetation types. The present report is the first study specifically on the bats of Fraser Island, and includes data on species occurrences and activity levels by vegetation type. Three methods of recording bats were used; direct capture, ultrasonic detection and spotlight observation. The merits and biases of each method as applied to surveying for micro- and megachiropterans will be discussed.

MATERIALS AND METHODS

The bat fauna of the central section of Fraser Island (25°23'S to 25°31'S — Fig. 1) was surveyed on nine trips of two to three days duration between May 1993 and March 1995. This gave a total of 20 nights of survey. Five trips were conducted during new moon and four during full moon. Mist nets and harp traps were set at ground level to capture bats in woodland to the north of Kingfisher Bay Resort on 18–20/11/94 and 2–3/3/95 with a total of ten trap-nights (all night) and four net-nights (3–5 hours per night). A total of 274.2 hours of ultrasonic monitoring for bat echolocation calls was carried out using bat detectors (Anabat II, Titley Electronics, Ballina, New South Wales) connected to hand held tape recorders (Realistic 2001, Tandy Electronics, Mt Druitt, New South Wales). Audio tapes of recorded calls were analysed using Anabat II signal analysis software (Anabat II, Titley Electronics, Ballina, New South Wales), and identification was based on comparison with reference calls supplied with Anabat II software, supplemented by calls recorded while releasing captured bats. Only calls with diagnostic features were used to identify species. It was frequently not possible to distinguish between calls of the two *Nyctophilus* species. These were recorded as "*Nyctophilus* species". Calls originating from bats but not identifiable to species were recorded as "Bat". Calls were separated into passes, which refers to a pass of a bat through the detection range of the bat detector. A pass was recognized as the point when a bat is first detected to when the call can no longer be

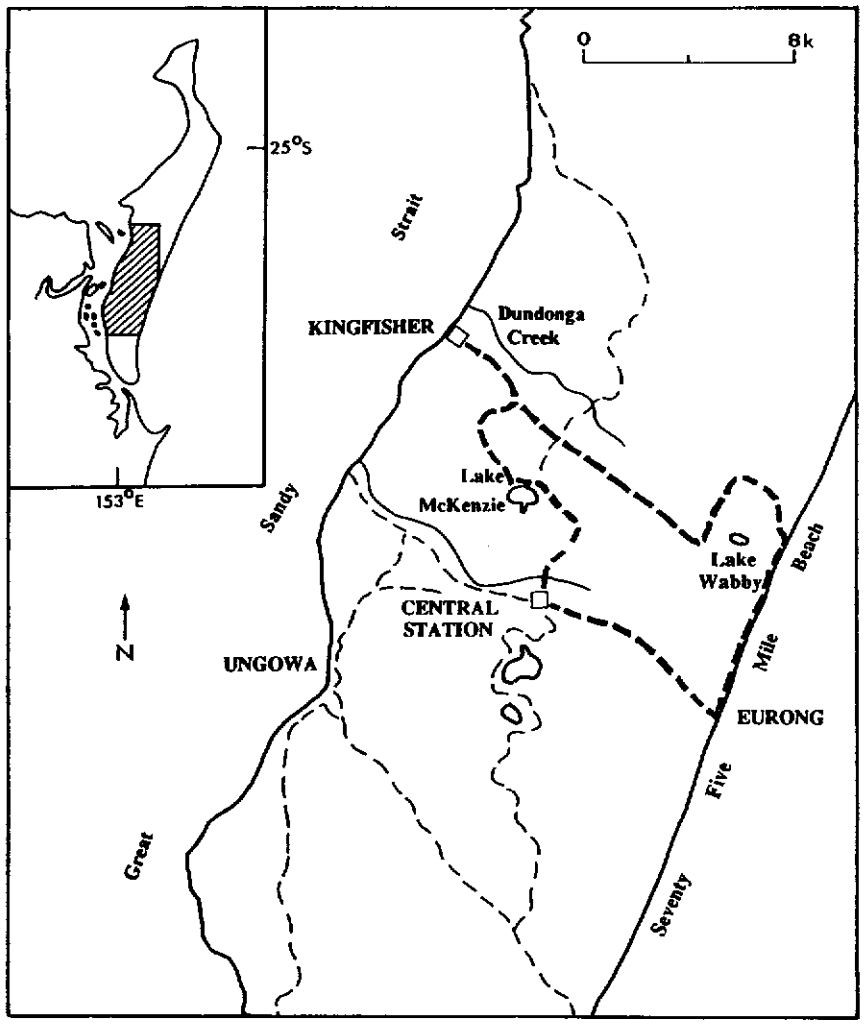

Figure 1. The study area on Fraser Island (shaded in inset) showing the location of recording areas at Kingfisher Bay Resort, Dundonga Creek, Lake McKenzie, Central Station and east coast. The thick dashed line represents the route of vehicle transect.

heard. The time interval between call pulses needed to distinguish closely occurring passes from a long pass was greater than two times the normal pulse interval. The number of passes per unit time provides a relative measure of bat activity, in contrast to numbers of individual bats obtained from direct capture.

Bat detectors connected to Delay Switches (Anabat II, Titley Electronics, Ballina, New South Wales) were used to record bats all night at the ponds in front of Kingfisher Bay Resort (11 nights) and at Dundonga Creek (nine nights) ("remote recordings" Fig. 1). Surveys with bat detectors were conducted on foot ("on-foot recordings") around Kingfisher Bay Resort (five times), Lake McKenzie (six times) and Central Station (six times). Ultrasonic call recordings were made with a bat detector from a vehicle travelling at 25 km/h over a 55.2 km transect along roads running from west to east across the island ("vehicle recordings"). With each call, an audio recording of the kilometres from origin was made using the vehicle odometer (at a resolution of 100 metres). As the vehicle speed was kept as constant as possible, the bat passes per unit distance were approximately equal to passes per unit time, and were used as a measure of relative bat activity for each habitat.

Visual observations were made with a 50 or 100 watt spotlight, primarily for megachiropterans feeding on fruiting and flowering trees at Lake McKenzie, Central Station, and around Kingfisher Bay Resort (Fig. 1). The flight behaviour of microchiropterans was observed using a spotlight to determine whether the bat was flying above, within, or below the canopy. The spotlight was used for a limited time so as not to interfere with the bats' behaviour, or deter bats while recording their calls.

The vegetation structure of the recording sites was assigned to one of the categories defined by Dwyer *et al.* (1979). The vegetation structure at recording sites around the Kingfisher Bay

Table 1. Records of bats by habitat type from: 1. remote and on foot detection (excluding vehicle detection), marked as d; 2. spotlighting, marked as s. Incidental observations were also recorded as incid.

Species	Sampling time (mins.)	Closed-forest 150	Open-forest Incid	Wood-land 600	Sedge-land Incid	Water 14400	Beach Incid	Cleared Incid
Pteropus alecto			s					
Pteropus poliocephalus		s	s	s				
Pteropus scapulatus			s	s				
Syconycteris australis				s	s			
Nyctimene robinsoni		s						
Saccolaimus flaviventris				d	d			
Chalinolobus gouldii						d	d	
C. morio				d		d		
C. nigrigriseus				d s		d	d s	
Miniopterus australis		d		d s		d		
M. schreibersii				d		d		
Myotis moluccarum				d		d	d s	
Nyctophilus gouldi						d		
N. bifax						d		
N. species (*gouldi* or *bifax*)				d		d		
Scotorepens greyii				d		d		
Mormopterus beccarii						d		
M. loriae				d		d		
Nyctinomus australis				d	d	d	d s	d

Table 2. Bat passes by vegetation type on vehicle transect. Data pooled from five transects. "km" refers to the total distance (of 55.2 km transect) represented by each vegetation type. "Bat" refers to a call originating from a bat but not identifiable to species.

Species	Km	Closed forest 1.7	Tall open forest 13.6	Open forest 16.1	Woodland 9.8	Heath 4.1	Beach 5.9	Cleared 0.3
Chalinolobus morio			1					
C. nigrogriseus			3	23	2	2		
Miniopterus australis		3	5	2	1			1
Scotorepens greyii				3	4	3		
Nyctinomous australis		1	2	1			2	1
Bat		1	11	14	6	4	1	
Total passes		5	22	43	13	9	3	2
Passes/km		0.47	0.32	0.53	0.18	0.63	0.1	1.33
Species/km		0.24	0.06	0.05	0.06	0.10	0.03	1.33

Resort was recorded on foot during the day. Along the route of the vehicle transect, the occurrence of vegetation types 50 meters each side of the road was recorded. The locations of changes in vegetation type were measured with the vehicle odometer at a resolution of 100 meters. A canopy gap was always present above the roadway, which was sometimes different in structure to the surrounding vegetation. As direct comparisons between calls recorded from vehicle transects and on foot are not valid, these data are presented separately. Information on location, vegetation structure and bat flight behaviour was added directly to the cassette tape.

RESULTS

The 20 survey nights resulted in a total of 18 bat species (5 megachiroptera and 13 microchiroptera). Bat detector recordings (excluding vehicle transects) and spotlighting revealed 13 species in woodland and over water, even though the sampling effort was far greater over water (Table 1). Four species (*Chalinolobus gouldii, Nyctophilus gouldi, Nyctophilus bifax* and *Mormopterus beccarii*) were recorded over water but not in forest. Fewer species were recorded in closed, open, sedgeland, beach and cleared habitats. Comparison between habitats must be made with caution, as dense vegetation may attenuate calls to a greater degree than less dense vegetation.

The 55.2 km vehicle transect route consisted mainly of open forest, tall open forest and woodland habitats (Table 2). Five species were recorded from five vehicle transects over the 55.2 km route. The highest number of species (five) was recorded from the tall open forest and open forest habitats. Bat passes occurred most frequently in heath and tall open forest habitats. The high figure in the cleared habitat must be interpreted with caution because of its small area (300 meters in length).

Twenty-six bats from six species were captured in 10 trap-nights and 4 net-nights in woodland between Kingfisher Bay Resort and

Dundonga Creek (Table 3; Fig. 1). The most frequently captured species were 7 *N. bifax* and 14 *N. gouldi* in harp traps. Two *Syconycteris australis* were captured at the same time in a net beside a clearing on the top of a ridge in woodland.

Table 3. Bats captured in woodland north of Kingfisher Bay Resort in 10 trap-nights and four net-nights.

Species	Number captured	Capture method
Syconycteris australis	2	Mist net
Chalinolobus morio	1	Harp trap
C. nigrogriseus	1	Harp trap
Miniopterus australis	1	Harp trap
Nyctophilus bifax	7	Harp trap
N. gouldi	14	Harp trap

DISCUSSION

The survey resulted in the capture or detection of 18 bat species on Fraser Island. This is greater than the previous total of eight species recorded by Barry and Campbell (1978), and John Kehl and Chris Corben (pers. comm.). An incidental bat survey of a nearby mainland site by Dwyer *et al.* (1979) revealed seven bat species. These surveys were either conducted over short periods, or were not specifically focused on bats or sampling vegetation types. The greater number of bat species recorded in the present survey results from greater survey time and the use of new techniques to record and capture bats. The number of species now listed for Fraser Island is closer to the number predicted from the distribution maps in Hall and Richards (1979), Strahan (1995), and Parnaby (1992). The 18 bat species constitute 49% of the mammalian fauna as described by Barry and Campbell (1978). Further surveys, covering a greater area of Fraser Island, may increase the species list by five species, *Rhinolophus megaphyllus, Chalinolobus dwyeri, Kerivoula papuensis, Scoteanax rueppellii* and *Vespadelus troughtoni* which include Fraser Island in their distribution (Strahan 1995). Several vegetation types listed in Barry and Campbell (1978), and Dwyer *et al.* (1979) were not sampled in the present survey, including saltmarshes, mangroves and heath habitats. These areas may have extra bat species to those recorded in this study.

The differences in occurrence by vegetation type for megachiroptera and microchiroptera (Table 1) were due mainly to differences in their foraging and feeding behaviour. Megachiropterans feed in vegetation, while most microchiropterans forage on the wing. Different survey techniques that were applied reflect this difference. Accurate identification of megachiropterans was possible only while the bats were feeding in vegetation, although *Nyctimene robinsoni* could be identified by its eye shine, size and high pitched whistle vocalization produced during flight. Identification of active microchiropterans was only possible while they were in flight and emitting echolocation calls. Except for closed forest, where spotlighting observations of animals in the canopy was difficult, similar numbers of megachiropteran species were recorded in all "wooded" areas. Microchiropterans were recorded in clear or cleared areas more often.

Ultrasonic detection of *Miniopterus australis* and *Nyctinomus australis* in five habitats indicate that they fly in open areas as well as in or over closed habitats. Spotlighting observations reveal *N. australis* above canopy level on all occasions, in contrast to *M. australis*, which often flew below canopy height in gaps and was captured in harp traps set on the ground. These observations were of presence of bats in particular vegetation types, and not mode of habitat use (i.e., foraging, commuting, or roosting). Nine microchiropteran species were recorded in closed-forest, open-forest and woodland. Twelve echolocating species were detected over water, however only one, *Myotis moluccarum*, was frequently seen dipping onto the water surface, suggesting insect capture and drinking. Other species may have been foraging on insects associated with open water. More extensive visual observations are necessary to determine the mode of habitat use.

Ultrasonic detection from vehicles resulted in records for five species from over 260 km (around 10 hours) of recordings. Although comparison between detection from vehicle transects and remote/on foot is difficult, 10 hours of detection on foot in woodland resulted in records for twice the number of species (10) from vehicle transects. The lower number of species recorded may be a result of the decreased signal to noise ratio imposed by the sound of the vehicle, or from bats actively avoiding the vehicle. While this bias must be kept in mind and overcome by recording using other means, vehicle transects can provide satisfactory comparisons of activity levels between widely spaced areas.

Although there was no specific search for flying fox camps on Fraser Island, it appears that most commute to the island from mainland camps at the mouth of the Mary River and at Hervey Bay. Except for reports of now-disused flying fox camps in Barry and Campbell (1978), there are no known camps on Fraser Island. This was confirmed by local rangers who reported *Pteropus scapulatus* and *P. poliocephalus* flying from the mainland to Fraser Island in early evenings. These species fly close to the sea surface during windy weather and sometimes collide with boat services running between Fraser Island and the mainland.

It also appears that *M. australis* and *M. schreibersii* fly to Fraser Island from mainland roosts. Both are obligate cave-dwellers (Hall and Richards 1979) and no suitable cave roost sites have been found on the island. These species are not known to use tree roosts and were not found roosting under log bridges in a search covering the main roads marked in Figure 1. The possibility that these species commute to the island from mainland roosts each night is reinforced by the earliest record of *M. australis* two hours after sunset and *M. schreibersii* five hours after sunset.

Surveying for bats by recording echolocation calls is biased against species with low intensity calls. Species such as *N. gouldi* and *N. bifax* with low intensity calls (Woodside and Taylor 1985) may have to be captured to determine their presence in an area, and will be under-represented in numbers of passes. The dectectability may also vary between habitats, as sound attenuation in dense vegetation may be sufficiently greater than more open vegetation, which would bias results toward low flying bats. Detector surveys along roadsides nearly always involve the vegetation canopy being disrupted above the road, which must be taken into account when interpreting ultrasonic surveys from vehicles. The recording of a call only indicates presence in the area sampled by the detector. If the detection range extends beyond the sampling area then it is not possible to assign calls to the sampling area, whether horizontal (i.e., vegetation type) or vertical (i.e., above canopy). Presence in a habitat must be reinforced by spotlighting observations or below-canopy captures. Capture data are biased as harp traps and mist nets usually only sample within 2–3 metres of the ground (as in this study), and some bats are able to detect and avoid these devices. Both of these capturing devices also are more effective with vegetation on either side of the capture area, to "funnel" bats in to be caught, and so are more effective in forest habitats. The best approach to take these biases into account, would be to employ ultrasonic detection, mistnets and harp traps, and visual observations in surveys.

More widespread surveys, and in particular more capture data in a range of vegetation types are necessary on Fraser Island to fully document it is bat fauna. The present study was limited to active chiroptera. The habitat required for roosting sites may differ markedly. Further studies on roost site use and availability are also necessary and will allow better management of bats on Fraser Island.

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